DOOSAN

Document Transmittal

Upper Trishuli-1 HEP (216MW)

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1	RN-0210	AN	UT1-C-020-CVL-OT-40012	0	ToR of Hydraulic Model Verification Test for Weir	
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Legend of Review Status
A : APPROVED
AN : APPROVED AS NOTED
RR : RETURN FOR RESUBMISSION
FI : FOR INFORMATION

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Discipline : Civil

UPPER TRISHULI-1 HEP (216MW)

Client	**Nepal Water and Energy Development Company Private Limited**
Owner's Engineer	**Tractebel Engineering GmbH / Jade Consult**

REVIEW NOTE

Contractor	**Doosan Enerbility**		
Title of the Document	ToR of Hydraulic Model Verification Test for Weir incl. App.		
Document No.	UT1-C-020-CVL-OT-40012	Revision	0
Date of Documents	02.08.2022	Received Date	02.08.2022
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		Present Review Status	**AN**

A: Approved AN: Approved as Noted RR: Returned for Resubmission FI: For Information, only

Comments:

The following should be included in the ToR:

- Test to be performed by whom, where, time period

Re-calibration of model:

- selected discharges,
- reference to numerical model, and/or
- reference to earlier model test by Doosan in China, and/or
- reference to earlier model tests by DJKV through hydro lab in Lalitpur/Nepal

Proposed Doosan layout:

- Flow conditions at power intake: discharges ranging from normal operation at Q = 76+10 m^3/s to 2-yr flood Q = 1013 m^3/s
- Flow conditions upstream of weir: discharges at various flood conditions starting with average monsoon flood Q = 868 m^3/s until 10,000-yr design flood plus extra tests for 2,000-yr design flood exceptional case with 'n-1'-gates
- The scope of testing to include number, size and location of gate openings, as well as modifications to right bank guide wall.
- In the first stage, satisfying flow conditions (related to water levels, turbulences and pulsations, dead water zones, even distribution of flow through openings) at weir and at power intake layout to be studied
- In the second stage the energy dissipation and riverbed protection on downstream side to be studied.
- Emphasize on tests for design floods: (i) 10,000-yr, and (ii) check of 2,000-yr n-1 case
- Physical model to include flow obstruction on left bank through fish pass structure
- Length of apron: velocity profiles at defined sections (velocity vs. time, i.e. turbulence impact on riprap protection),

The tests shall include testing of various modifications if and when required.

Detailed Comments

- Section 1, Introduction: Who and where will the model tests been carried out?

- Section 1.3, Physical model currently available:
  - "*fish way structure*" or fish path must by included in the model as a physical element impacting on the downstream flow on the left bank (not as a element for discharge which is negligible). Flow might be deflecting on left bank at the structure and structure may experience high flow velocities triggering erosion and instability to the fish path structure.

  - Right bank guide wall needs to reflect layout drawings. This guidewall may be tested with variations to improve approach flow conditions to the weir

- Section 2, Test Purpose:
  - Insert after "*feasibility and appropriateness of*", "*and if found necessary to alter and improve*".
- Section 3, References:
  - (3) revised Detal Design Report, Weir & Spillway: Which document is the reference exactly to? Which version?
- Section 4, Flood Control Standards:
  - (3) "*The downstream energy dissipation and erosion protection shall be designed to pass 200-year frequency flood (2,554.8 m3 /s).*" Not agreed. The contract does not foresee to have a reduced design flood for the downstream energy dissipation.
  - Here may be a differentation into the part which is directly related to the weir and its stability. This then includes the apron and its direct riprap riverbed protection.
  - The river protection works at the banks downstream of the apron may be designed for a lower return period, e.g. 200-yr, since failure of these elements will not endager stability of the weir structure itslef and can be easily repaired after big flood events, if required.
- Section 5, Test Plan:

  Calibration:
  - At the beginning of the tests, the model needs to be re-calibrated, in order to either (i) confirm hydraulic conditions of the earlier tests conducted in China, or (ii) to confirm matching of model with numerical modelled water levels for a wide range of discharge – not only lower discharge.
  - The water levels documented at site since construction started should be used for calibration.
  - Discharges selected for calibration should be included in the ToR?

  Test for weir and power intake for recommended layout at start, and for improved layout during the tests:
  - Number of discharges to be studied for weir layout optimisation should be reduced in order to reduce required testing time: OE recommends the following discharges: average monsoon flow = 411 m^3/s, mean monsoon flood = 868 m^3/s, 2-yr flood = 1013 m^3/s (to confirm continued intake operation), 10-yr flood = 1602 m^3/s (to confirm necessity of intake closure), 100-yr flood = 2337 m^3/s, 2000-yr flood = 3276 m^3/s, and 10000-yr flood = 3780 m^3/s.

- The tests for 200-yr flood and 5000-yr flood could be skipped for most of the tests.
- Section 5.1.1 to 5.1.6: gate openings to be only for the start of tests. Changes of gates settings are not excluded, if giving better results or better hydraulic performance.

Test for downstream energy dissipation for optimised layout:

- Number of discharges to be studied for downstream protection works should be further reduced in order to reduce required testing time further: OE recommends the following discharges: mean monsoon flood = 868 m^3/s, 10-yr flood = 1602 m^3/s, 2000-yr flood = 3276 m^3/s, and 10000-yr flood = 3780 m^3/s.

- Section 6, Test cases and measuring data:
  - (2) Flow pattern & velocity: Velocity profile at defined cross sections: (i) at least two measuring points on the vertical axis at each of the gate openings, and (ii) at end of apron across the width of the river (5 measuring points, two vertical measuring points). Recording of velocity fluctuations to estimate turbulence which has impact on river protection works and bed stability.
  - (4) Tests d/s of apron can be initially conducted with fixed river bed to record flow velocities. Scouring tests otherwise provide qualitative results only. It is desirable to test the designed river bed protection in the physical model to confirm riprap size and length of apron.
  - Testing program should be listed separately for (i) calibration, (ii) aproach flow condition of weir and power intake, and (iii) downstream erosion protection.
- New Section 7, Test for improved layouts:
  - If aproach flow conditions to the weir are not satisfactory, modifications shall be proposed and tested. Modifications for testing shall be agreed with OE prior to testing. The modifications may include (i) right bank guide wall, (ii) size of weir openings, (iii) location of weir openings, (iv) number of weir openings. The list given is not comprehensive, other modifications may be suggested.
  - Length of downstream apron: The velocities downstream of the apron should not be significantly different before and after construction of the weir. If downstream of the As long as significant differences can be measured, the apron should be extended in length.

Disclaimer:

Any approval will not release the Contractor from any of his obligations under the Contract. Despite the Engineer's approval the Contractor remains fully responsible for design, calculation, dimensioning, supply and installation without limitations.

Dr Frank Negrassus, hydraulic specialist